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HEARING LEVELS of NOISE-EXPOSED U.S. AIR FORCE PERSONNEL COMPARED TO THOSE IN THE TOTAL U.S. POPULATION

September 1976

Progress Report for Period January-June 1975

USAF SCHOOL OF AEROSPACE MEDICINE
Aerospace Medical Division (AFSC)
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Hearing threshold levels as reported on forms received at the USAF Hearing Conservation Data Registry were studied. Forms received during January through June 1975 were included. Median hearing levels for both military and civilian USAF personnel were found to be generally better than in the noninstitutionalized United States population.

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HEARING LEVELS OF NOISE-EXPOSED U.S. AIR FORCE PERSONNEL COMPARED TO THOSE IN THE TOTAL U.S. POPULATION

INTRODUCTION

Many military and civilian USAF personnel perform their duties in the presence of noise levels that are judged a potential threat to hearing. In 1949, a regulation (1) was published that recognized noise as a hazard, provided for ear protection use, and called for audiometric testing of persons exposed to high-intensity sound. This one-page regulation provided very little detail. In 1956, a 25-page regulation (2) imposed a great deal of detailed guidance, including a requirement to send carbon copies of all monitoring audiometry reports, on AF Forms 1490 (Hearing Conservation Data) to a central Repository. In 1973, a revised regulation (3) (52-pages) was issued and obviously exerted a big influence since the number of carbon copies of audiometric monitorings received at the USAF Hearing Conservation Data Registry (formerly the Repository) more than doubled.

Prior to 1975, the hearing conservation data forms sent to the Registry (Repository) were used primarily to generate broad generalizations about the noise-exposed population being monitored. For example, tabulations were usually of items such as numbers of military, numbers of civilians, numbers with very good, in-between, and very bad hearing thresholds. Computer processing of all hearing conservation data did not begin until 1975. Copies of two types of forms are received at the Registry: AF Forms 1491 (Reference Audiogram) document an individual's hearing threshold levels (HTL) prior to his duties in noise and serve as a reference against which to compare subsequent audiometric examinations. AF Forms 1490 are used to record all followup audiometric results and have the reference audiogram transcribed onto them so that threshold shift at each pure-tone frequency can be conveniently calculated. Most of these are annual followups. When a significant threshold shift (according to criteria in the regulation) is found, other followups are done including 15- and 40-hour reexaminations, monthly detailed followups, and other special purpose followups. Keypunching of data for computerization has been limited to information on AF Forms 1490.

The purpose of this report is to document the hearing threshold levels of noise-exposed Air Force personnel and to compare these hearing levels to those reported for the U.S. population. Military and civilian hearing levels are considered separately.

METHOD

Hearing conservation data received from January through June 1975 at the USAF Hearing Conservation Data Registry, Brooks AFB, Texas, and stored by computer (from AF Forms 1490 that had complete audiometric information and were reports on annual followup audiograms) were used to extract the hearing levels reported.

The data were extracted at audiometric frequencies of 500, 1000, 2000, 3000, 4000, and 6000 Hz in age groups 18-24, 25-34, 35-44, 45-54, and 55-64, with military and civilian data kept separately. Data from each frequency and each ear were tabulated to show the number of persons represented at each hearing threshold level from 0 through 80+ dB(ANSI-1969); the count was then converted to a percentage distribution. Also, the median hearing threshold level was extracted for all conditions.

RESULTS

The number of audiometric records on military and civilian personnel is tabulated by age in Table 1 with percentages given for the number in each age group. Military and civilian numbers are distributed differently: the greatest number of military records is in the 25-34-year-age group (43.7%), whereas the greatest number of civilians is in the 45-54-year group (32.2%). Further, 96% of the military represented are under 45 years of age while 48.4% of the civilians are 45 or older.

Median hearing threshold level is shown in Table 2 for each age group in this study. There is a distinct pattern of increasing HTL (poorer hearing) with increasing age except at 500, 1000, and 2000 Hz for military personnel between the two youngest age groups. The military records show improved HTL between the 18-24 and 25-34-year age groups at these three frequencies.

Median HTLs are consistently better for the right ear. Every right-ear median is better than the left at the corresponding frequency and age, except civilians, aged 55-64, at 500 Hz have a median HTL of 12.1 dB for right and left ears.

The increase in HTL (change to poorer hearing) with increasing age is much greater for 3000, 4000, and 6000 Hz. The difference between best and poorest median HTL with increasing age is progressively greater with progressively higher frequency, except for 6000 Hz. There is a bigger change at 4000 Hz than at 6000 Hz except for the right ear of military personnel. The generally greater loss for 4000 Hz forms the well-known 4000 Hz notch that is associated with noise-induced hearing loss.

The main purpose of this study was to compare the hearing levels of noise-exposed Air Force personnel to that in the general U.S. population (7) (Figure 1). Air Force HTLs are displayed separately for military and civilian personnel. A consistent pattern of better hearing for the military can be seen with the only exceptions in the 18-24-year-old groups. Median

HTL for the U.S. population is poorer than for the military Air Force personnel except for 500 Hz in the left ear in the 18-24-year-age groups. Air Force civilian personnel show generally better hearing than the total U.S. population but with several exceptions. The most notable exception is in the 45-54-year-age group at 4000 and 6000 Hz where Air Force civilians have poorer median HTL for both ears than does the U.S. population.

The median HTLs in Figure 1 are all based on calibration specified in ANSI S3.6-1969 (4). The U.S. Air Force adopted the ANSI-1969 standard at about its time of publication and has therefore had about 5 years to effect the audiometer calibration conversion. The U.S. Public Health Service Health Examination Survey (HES) was done with audiometers calibrated to the ASA-1951 standard (5) with the Cox and Bilger (6) recommended values. The two calibration standards are shown in Table 3. The differences between the two standards were added to the median HES HTLs before entry into Figure 1. Both the U.S. Public Health Service and the U.S. Air Force use TDH-39 earphones with MX-41/AR cushions.

In Table 4, the distribution of hearing threshold levels is given for all frequencies, right and left ears, military and civilian, for each age group. The skewing expected with audiometric pure-tone threshold distributions is well in evidence, and the percentage in each interval containing the median for that column is underlined. A strong central tendency does not appear in hearing levels at the higher frequencies for the older groups. The interval containing the median for these older groups has a relatively small percentage of the hearing levels represented. Specifically, in age groups 45-54 and 55-64 at 3000, 4000, or 6000 Hz, the highest percentage in an interval containing a median is 10.3 which is at 3000 Hz, right ear, for military in age group 45-54.

The generally better hearing for noise-exposed Air Force personnel than for the U.S. population can be attributed in part to the Air Force admission requirements. Since 1956, the Air Force has had a policy to reject a person from entry into duties in noise if his hearing for 500, 1000, and 2000 Hz averaged 30 dB or more, ANSI (20 dB ASA) in either ear. The USPHS study indicated that about 1% of the U.S. population, age 18-24, would fail that criterion in the better ear. Since the Air Force rejects on the basis of the poorer ear, we know that over 1% of the 18-24-year-old general population would not normally be admitted into duties in noise. The better hearing for military than for civilian members of the Air Force can be attributed to the more stringent hearing requirements for the military, particularly officer and flying personnel. For initial commission or for entry into flying training, a person must have a HTL no poorer than 25 dB ANSI (previously 15 dB ASA) at 500, 1000, and 2000 Hz in either ear; further, he must have an average HTL no greater than 45 dB ANSI (previously 35 dB ASA) for 3000, 4000, or 6000 Hz, both ears averaged together.

A major factor in the generally good hearing for noise-exposed Air Force personnel is considered to be the comprehensive Air Force hearing conservation program that has been active since 1956. The monitoring audiometry portion is a key part of this program. Each noise-exposed

Air Force member is given an annual audiogram, and the results are immediately compared to his reference hearing levels which were determined before his entry into duties in noise. A threshold shift (change from reference to annual) of 20 dB or more at any frequency, either ear, is designated significant if all hearing levels on the reference audiogram are 25 dB or better. If the reference audiogram has any HTL of 30 dB or more, threshold shift is significant if it is 10 dB or more at 2000 Hz, 15 dB or more at 3000 Hz, or 20 dB or more at 4000 or 6000 Hz. Table 5 shows the results of these criteria applied to Air Force personnel within the 6-month period studied. The percentage with significant threshold shift is progressively greater with increasing age. When military and civilian Air Force members are combined, 25.3% are designated as having a significant threshold shift; very few of these are subsequently removed from their duties in noise. They are customarily followed up with audiograms done after 15 hours and after 40 hours of auditory rest. If either test shows a return to no significant threshold shift, the person is reindoctrinated in the harmful effects of noise, refitted with ear protection, and reinstructed in its use. The objective is to apply corrective action so that noise-induced hearing loss does not occur in the future. A physician examines for apparent cause of the loss before the 40-hour followup.

If a person continues to reflect significant threshold shift, even after 40 hours auditory rest, he may be enrolled in a 5-month detailed followup program to see if his hearing has stabilized or if he is continuing to shift to even poorer HTLs. If HTL remains stable over the 5-month period, the person is returned to annual audiometric monitoring. Further loss during the 5 months is cause to recommend removing the person from duties in noise. If further loss is at 500, 1000, 2000, or 3000 Hz, the person is referred for otologic evaluation since a shift in these lower frequencies might be due to causes other than noise. The number of persons actually removed from duties in noise because of significant threshold shift is probably quite small. Data in the Registry indicate that about 10% of personnel receiving an annual audiometric examination will have a significant threshold shift that continues through both the 15-hour and 40-hour noise-free periods. The number of persons showing further significant threshold shift during the 5-month detailed followup is estimated to be very small.

In summary, military and civilian noise-exposed U.S. Air Force personnel reflect better hearing levels than the general U.S. population. Within the Air Force, military personnel have better hearing than civilian members. The better hearing for Air Force personnel can be partly attributed to entry standards. However, the comprehensive hearing conservation program that identifies and arrests early noise-induced hearing loss is the most probable cause for the good hearing.

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Raul Garcia and Richard Medina of the Biometrics Division, USAF School of Aerospace Medicine, planned and carried out all the computer storage and manipulation required for completion of this study.

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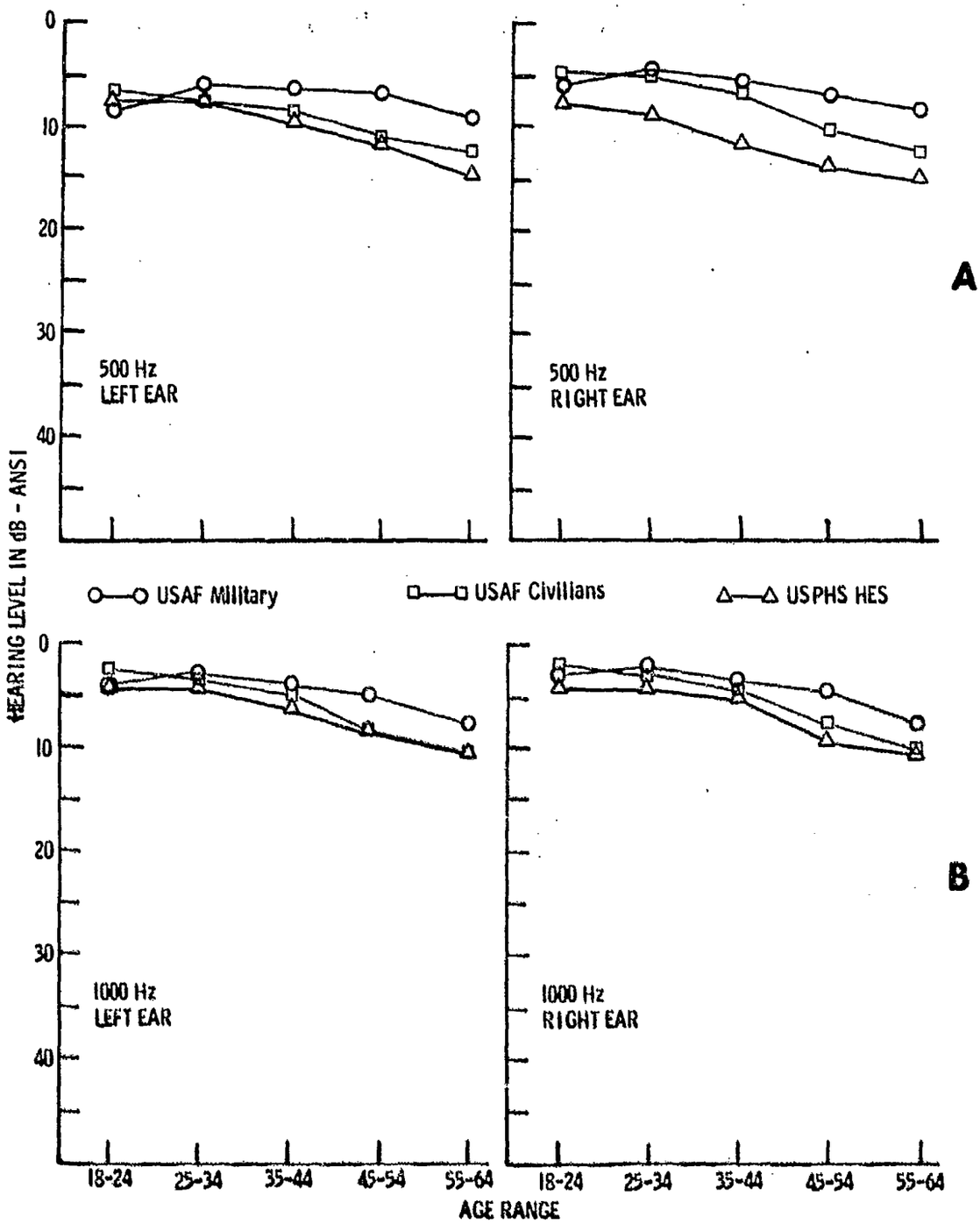
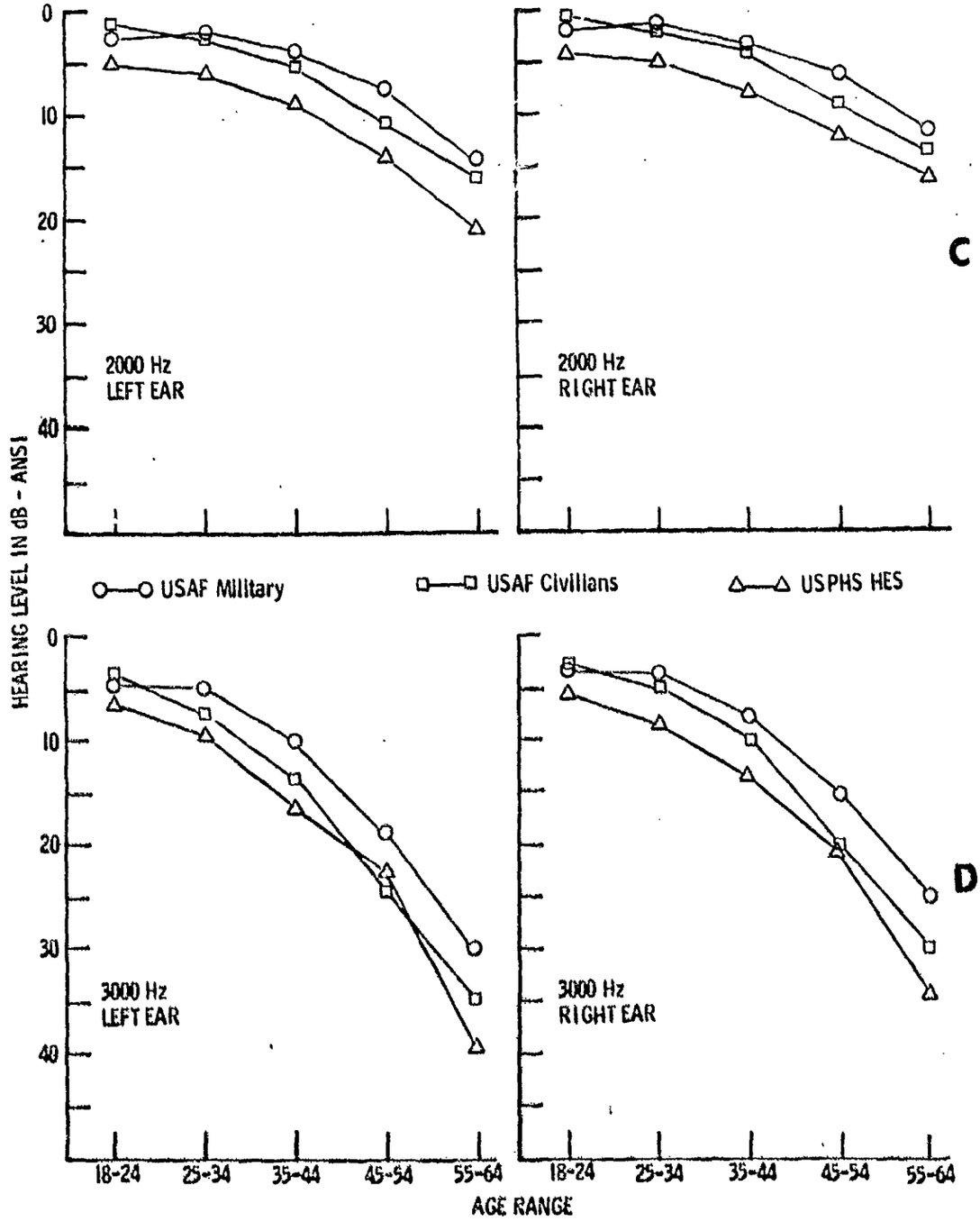


Figure 1. Median hearing levels for military and civilian noise-exposed personnel and for the U.S. population (HES) (7): (A) 500 Hz, (B) 1000 Hz, (C) 2000 Hz, (D) 3000 Hz, (E) 4000 Hz, and (F) 6000 Hz.



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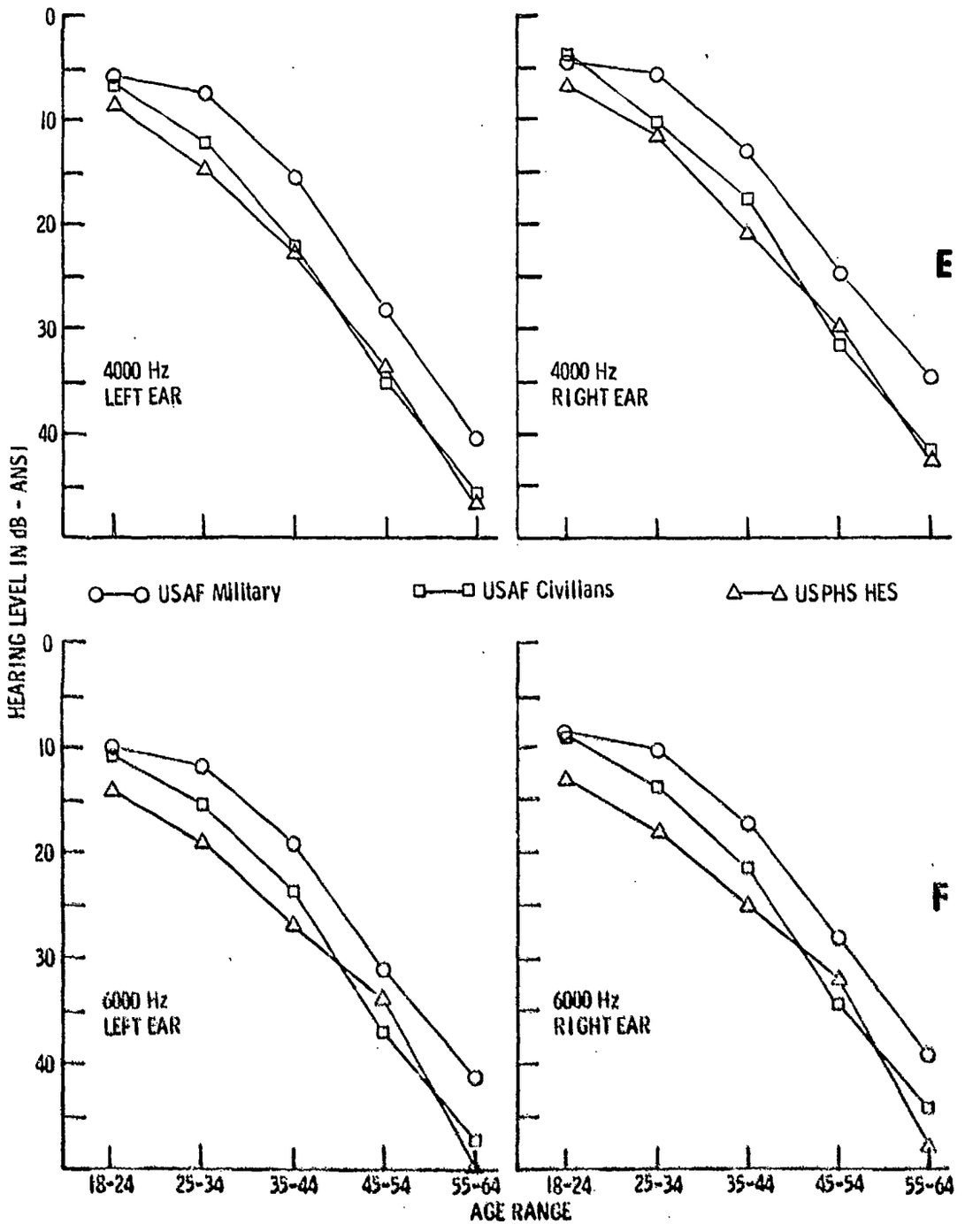

Figure 1. (Continued)

TABLE 1. AUDIOMETRIC RECORDS FOR MILITARY AND CIVILIAN PERSONNEL

Age Group	Military N	Military %	Civilian N	Civilian %
18-24	14,110	29.2	366	4.2
25-34	21,092	43.7	2,186	25.2
35-44	11,148	23.1	1,933	22.2
45-54	1,734	3.6	2,794	32.2
55-64	178	.4	1,410	16.2
	48,262	84.7	8,689	15.3

Total military and civilian = 56,951

TABLE 2. MEDIAN HEARING THRESHOLD LEVEL

Age Group	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
Military												
18-24	8.4	3.9	2.8	4.5	5.8	9.9	5.9	2.9	1.7	3.2	4.3	8.4
25-34	5.9	2.8	2.0	4.9	7.6	11.8	4.2	2.1	1.1	3.5	5.7	10.1
35-44	6.2	3.9	3.9	9.9	15.6	19.1	5.1	3.3	3.0	7.8	13.0	17.1
45-54	6.8	4.9	7.6	18.9	28.1	31.3	6.7	4.4	6.0	15.2	24.6	28.1
55-64	9.1	7.7	14.1	30.0	40.3	41.6	8.1	7.4	11.4	25.0	34.4	39.2
Difference[a]	3.2	4.9	12.1	25.5	34.5	31.7	3.9	5.3	10.3	21.8	30.1	30.8
Civilian												
18-24	6.6	2.5	1.2	3.6	6.5	10.9	4.4	2.0	.5	2.5	3.8	8.7
25-34	7.4	3.5	2.8	7.6	12.2	15.3	4.9	3.0	2.0	4.9	10.1	13.6
35-44	8.2	4.9	5.3	13.7	22.0	23.8	6.8	4.2	4.0	10.1	17.6	21.3
45-54	10.9	8.2	10.8	24.4	35.1	37.1	10.1	7.5	8.9	20.2	31.5	34.2
55-64	12.1	10.2	16.0	34.9	45.6	47.4	12.1	9.9	13.4	29.9	41.5	44.2
Difference[a]	5.5	7.7	14.8	31.3	39.1	36.5	7.7	7.9	12.9	27.4	37.7	35.5

[a]Difference in dB, between best and poorest median hearing threshold level.

TABLE 3. AUDIOMETER ZERO REFERENCE STANDARDS USED BY USPHS (HES) AND USAF

Frequency (Hz)	HES ASA-1951	USAF ANSI-1969	Difference
	decibels sound pressure level		
500	24.1	11.5	12.6
1000	17.2	7.0	10.2
2000	18.0	9.0	9.0
3000	15.6	10.0	5.6
4000	14.3	9.5	4.8
6000	19.5	15.5	4.0

TABLE 4. PERCENT DISTRIBUTION OF HEARING THRESHOLD LEVEL

Age 18-24

Hearing level (dB)	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
Military												
<0	9.6	25.3	34.6	28.5	25.3	16.6	15.9	31.3	40.2	33.1	28.9	19.1
5	22.1	31.7	27.6	24.0	21.7	17.4	29.5	32.8	29.0	26.8	24.5	18.9
10	27.3	21.6	17.8	19.1	18.5	16.4	25.8	19.2	15.5	17.6	18.1	17.8
15	24.1	13.4	11.2	13.4	14.3	16.7	17.2	9.8	8.7	11.4	12.4	15.7
20	9.6	4.1	4.4	6.6	7.0	10.6	6.5	3.5	3.1	4.9	5.5	10.1
25	4.3	2.0	2.3	3.6	4.3	7.9	2.7	1.6	1.6	2.5	3.5	6.4
30	1.7	.8	.9	1.6	2.2	4.1	1.0	.6	.5	1.1	1.6	3.0
35	.6	.4	.5	1.0	1.5	2.7	.5	.4	.4	.7	1.4	2.4
40	.3	.3	.2	.6	1.2	1.8	.3	.3	.3	.4	.9	1.4
45	.2	.2	.3	.5	1.0	1.5	.2	.2	.2	.4	.7	1.2
50	.1	.1	.1	.3	.9	1.0	.1	.1	.2	.4	.7	.9
55		.1	.1	.3	.7	.9	.1	.1	.1	.3	.6	.8
60		.1		.1	.4	.7	.1	.1	.1	.1	.4	.6
65				.2	.3	.5		.1	.1	.2	.4	.7
70				.1	.3	.4				.1	.2	.4
75					.1	.4			.1		.1	.3
80					.1	.2					.1	.2
>80					.1	.3					.1	.3
Civilian												
<0	12.3	33.3	43.2	31.7	22.4	12.6	14.2	34.4	47.3	37.2	28.7	15.0
5	28.4	32.8	28.1	25.7	22.7	17.8	40.4	39.3	30.1	26.0	28.4	21.3
10	27.6	20.0	13.1	15.3	16.1	16.7	23.5	14.5	10.1	15.6	12.6	18.3
15	19.4	8.2	9.3	12.3	15.9	16.9	12.8	6.6	5.7	10.7	10.9	14.8
20	7.9	3.3	2.2	4.6	4.6	8.2	3.8	2.7	3.0	4.6	5.5	7.1
25	3.3	1.4	2.5	3.8	3.6	7.1	3.0	.8	1.9	3.3	3.0	8.7
30		.3	.8	1.9	1.9	2.7	.8	.3	.8	1.1	2.5	4.1
35	.3	.6	.3	1.1	2.2	5.5	.8	.3	.3	.3	1.4	3.3
40			.3	.8	1.6	3.0	.3	.8	.6	.3	2.2	.6
45	.3		.3	.6	2.7	2.7					1.9	2.5
50				.6	.8	.8				.6	1.1	.8
55		.3		.8	1.6	2.5				.3	.8	.8
60	.3				1.6	1.1				.3	.3	.8
65				.8	.6	.8	.3	.3	.3			.3
70					1.4	1.1					.6	.6
75					.3	.3						.3
80												
>80						.3					.3	.8

TABLE 4. (Continued)

Age 25-34

Hearing level (dB)	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
Military												
<0	17.3	32.6	39.7	27.9	21.4	13.4	23.1	36.6	44.0	32.6	25.1	15.4
5	28.1	31.4	26.1	22.4	19.2	15.2	32.2	32.6	27.6	25.2	22.7	17.0
10	26.0	19.5	16.4	17.7	17.6	15.6	23.0	17.3	14.7	17.4	16.9	17.2
15	17.3	10.2	9.8	13.6	13.9	15.9	13.6	8.2	7.8	11.2	13.0	15.9
20	6.7	3.6	4.0	6.9	8.0	11.7	4.7	2.9	2.9	5.4	6.9	10.6
25	2.8	1.6	2.2	4.3	5.6	8.4	2.1	1.1	1.5	3.1	4.6	7.1
30	1.0	.5	.8	2.1	3.3	4.7	.6	.4	.5	1.6	2.4	4.1
35	.4	.3	.4	1.5	2.5	3.6	.4	.3	.4	1.0	1.9	2.8
40	.2	.2	.3	1.1	1.9	2.5	.2	.1	.2	.6	1.5	2.1
45	.1	.1	.1	.9	1.5	2.0	.1	.1	.2	.5	1.2	1.6
50			.1	.5	1.2	1.6	.1	.1	.1	.4	1.0	1.4
55			.1	.4	1.1	1.3			.1	.3	.8	1.1
60				.3	.8	1.1			.1	.2	.6	.9
65			.1	.2	.7	.9				.2	.5	.9
70				.1	.4	.6				.1	.3	.5
75				.1	.2	.6				.1	.4	.5
80				.1	.1	.4					.2	.3
>80				.1	.2	.5				.1	.2	.6
Civilian												
<0	8.1	23.7	33.6	19.5	11.9	6.9	13.1	26.7	37.6	23.7	14.7	8.8
5	29.1	37.2	29.6	22.0	17.1	13.4	37.4	38.4	31.1	26.8	20.5	14.7
10	26.5	20.4	15.6	16.4	14.2	13.5	23.2	18.5	15.4	16.4	14.7	15.3
15	23.6	12.0	11.7	15.5	15.7	15.6	16.5	10.4	8.7	12.7	15.1	15.7
20	6.7	3.7	4.3	7.3	9.2	10.4	5.3	2.8	3.1	6.5	8.1	10.0
25	3.5	1.7	2.3	6.0	7.3	10.3	2.5	1.5	1.7	3.7	6.1	8.7
30	1.4	.6	1.1	2.4	3.7	6.0	1.0	.6	.6	2.3	3.9	4.4
35	.6	.2	.7	2.7	4.4	4.9	.4	.4	.6	1.8	2.7	4.6
40	.1	.2	.2	2.3	3.1	2.4	.2	.1	.4	1.1	2.6	3.0
45	.2	.1	.3	1.5	3.0	3.4	.1	.1	.3	1.0	2.4	3.3
50		.1	.1	1.8	2.0	2.6	.1	.2	.2	1.3	1.7	1.7
55	.1	.1	.2	.8	2.3	1.7	.1	.1	.3	1.0	1.9	2.2
60			.1	.8	1.2	1.9	.1	.1	.1	.6	1.8	1.8
65	.1	.1	.1	.5	2.4	2.6		.1	.1	.7	1.8	1.7
70				.3	1.0	1.3				.3	1.0	1.1
75			.1	.2	.8	1.4				.1	.7	1.5
80		.1		.1	.4	.4				.1	.3	.6
>80				.1	.3	1.2	.1	.1	.1	.1	.2	1.0

TABLE 4. (Continued)

Age 35-44

Hearing level (dB)	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
					Military							
<0	16.9	26.0	29.7	16.7	10.4	6.6	20.7	28.6	33.9	19.4	12.0	7.3
5	27.0	30.9	26.0	16.4	10.8	7.8	28.9	32.2	27.1	20.3	14.1	9.8
10	25.1	22.2	18.4	17.2	13.7	11.5	23.6	20.6	17.4	18.0	15.5	13.4
15	18.4	12.5	12.4	15.2	13.9	14.0	15.9	11.1	11.0	14.4	14.4	14.4
20	7.1	4.5	6.0	9.5	10.4	12.5	5.8	3.9	4.8	8.6	10.5	12.3
25	3.2	2.1	3.4	7.4	9.4	10.9	2.8	1.9	2.5	5.6	8.1	10.5
30	1.0	.8	1.5	4.2	6.5	7.4	1.0	.8	1.3	3.5	5.0	6.9
35	.5	.4	1.0	3.2	5.0	6.1	.6	.3	.7	2.4	4.0	5.2
40	.2	.3	.6	2.5	3.8	4.4	.3	.2	.3	2.0	3.5	3.8
45	.2	.1	.3	2.0	3.4	3.7	.2	.1	.3	1.7	2.8	3.4
50	.1	.1	.2	1.8	3.2	2.8	.1	.1	.2	1.1	2.5	2.5
55			.2	1.1	2.5	2.7	.1	.1	.1	1.0	2.2	2.3
60		.1	.1	1.1	2.2	2.5			.1	.7	1.5	1.7
65		.1	.1	.7	1.7	1.9			.1	.6	1.2	1.7
70			.1	.4	1.2	1.4			.1	.2	1.0	1.4
75			.1	.3	.8	1.2				.2	.7	1.2
80				.2	.6	1.1				.1	.4	1.0
>80				.1	.7	1.7				.2	.7	1.5
					Civilian							
<0	8.6	19.4	23.4	9.0	4.7	3.3	11.2	21.2	25.6	12.2	6.4	3.9
5	24.7	31.3	25.7	16.9	9.0	6.3	31.0	34.0	30.4	21.1	11.0	9.1
10	25.8	21.7	17.7	15.0	10.7	9.1	21.7	21.4	17.0	16.5	12.2	9.9
15	24.0	16.5	13.6	12.4	11.5	12.4	20.1	12.9	12.4	13.9	16.0	13.1
20	8.1	5.2	7.7	9.6	10.3	9.7	7.0	4.6	5.8	8.8	8.6	10.9
25	4.8	2.6	4.6	7.0	9.6	12.2	4.4	2.9	3.2	6.1	8.9	11.6
30	1.7	1.2	2.0	5.6	6.6	7.1	2.0	1.1	1.0	5.0	5.7	6.7
35	.8	.8	1.4	5.0	6.1	7.5	1.1	.6	1.1	3.4	5.8	6.4
40	.4	.4	.6	4.0	5.0	4.9	.4	.6	.9	1.9	3.7	4.4
45	.7	.4	.9	3.1	5.3	4.9	.7	.2	.6	1.7	3.8	4.0
50	.2	.1	.7	3.1	4.5	3.3	.2	.1	.3	2.0	3.4	3.2
55	.2	.3	.8	3.1	4.4	4.1	.2		.7	2.4	4.2	2.6
60	.1	.1	.5	1.9	3.6	2.9	.1	.2	.5	1.5	2.7	3.1
65	.1	.1	.3	1.4	2.4	3.4	.1	.1	.2	1.4	2.3	2.6
70	.1	.2	.1	1.1	1.9	1.6		.1	.1	1.0	1.8	2.6
75		.1	.1	.8	1.7	2.3	.1	.1	.1	.6	1.5	2.1
80			.1	.5	1.1	1.8	.1	.1		.3	.7	1.4
>80			.1	.6	1.9	3.5	.1	.1	.1	.4	1.4	2.6

TABLE 4. (Continued)

Age 45-54

Hearing level (dB)	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
					Military							
<0	15.1	20.2	18.8	7.8	4.0	2.6	15.9	21.4	22.3	10.7	4.7	3.4
5	25.5	30.7	21.5	11.1	5.9	4.6	25.7	32.5	24.1	10.6	6.8	4.4
10	25.9	22.3	18.6	10.0	8.0	4.9	25.1	21.1	18.8	14.1	11.0	7.0
15	18.5	14.9	14.8	13.8	9.6	9.0	17.4	13.8	14.0	14.1	10.2	9.4
20	8.3	5.5	9.5	9.2	9.2	9.8	8.7	5.3	7.1	10.3	9.2	11.4
25	3.4	3.5	4.6	8.5	8.8	9.5	3.9	2.9	5.1	8.5	8.9	9.3
30	1.6	.9	3.9	8.0	7.7	7.9	1.4	1.3	2.6	6.4	7.0	8.0
35	1.0	.9	2.5	4.7	7.4	6.9	.9	.7	2.3	5.5	7.6	6.6
40	.2	.5	1.6	5.6	7.2	6.3	.5	.2	1.3	3.6	5.7	5.8
45	.2	.2	1.2	5.6	5.9	5.9	.1	.2	.9	3.5	4.6	5.3
50	.1	.1	.9	4.1	5.8	6.3	.2	.4	.4	3.6	4.7	5.2
55	.2	.2	.9	3.6	4.9	5.2	.1	.1	.3	3.1	4.9	4.3
60	.1	.2	.8	2.8	4.2	4.8	.1	.1	.4	2.5	4.6	5.1
65	.1	.1	.3	1.9	4.6	4.4		.1	.1	1.3	3.9	3.9
70			.1	1.7	2.4	3.1	.1		.1	.7	2.1	2.7
75			.1	.8	1.6	3.0	.1	.1	.2	.7	1.6	2.1
80			.1	.4	1.1	2.1		.1	.1	.3	.9	1.9
>80				.5	2.1	3.7	.1		.1	.6	1.8	4.2
					Civilian							
<0	4.2	10.1	10.7	3.8	1.4	1.2	6.6	12.0	13.0	4.3	1.4	1.3
5	18.2	25.3	20.1	7.4	3.3	2.4	21.6	27.0	24.3	10.5	4.8	3.4
10	23.4	22.6	16.4	9.4	4.8	3.5	21.3	22.1	16.2	11.2	6.5	4.3
15	24.9	20.0	17.2	12.2	8.1	7.6	23.2	18.7	17.0	14.0	10.6	7.7
20	12.5	9.0	10.1	8.7	7.1	7.1	10.2	8.2	9.0	9.6	8.2	8.0
25	8.3	5.9	8.5	9.7	8.6	9.7	7.7	4.7	6.2	9.6	9.8	10.0
30	3.3	2.5	4.3	7.1	7.6	8.0	2.9	2.1	3.4	6.2	6.6	8.1
35	2.0	1.6	3.7	7.1	8.9	8.0	2.6	1.5	2.7	5.4	7.1	8.8
40	1.2	1.0	2.3	5.8	6.8	6.6	1.1	1.0	1.9	5.3	5.9	6.1
45	.8	.9	2.1	6.2	7.1	7.8	.8	.7	1.5	4.9	7.3	6.5
50	.4	.4	1.1	5.3	6.3	5.1	.6	.6	1.3	4.4	5.6	5.1
55	.2	.2	1.5	5.6	8.1	6.3	.4	.4	.6	5.0	6.7	6.1
60	.3	.2	.4	3.5	5.4	4.6	.2	.3	.9	2.8	5.2	5.2
65		.1	.7	3.4	5.6	6.0	.1	.4	.5	2.8	4.0	4.7
70	.1	.1	.1	1.9	3.2	4.3	.4	.1	.4	1.2	2.7	3.4
75		.1	.3	1.3	3.2	4.1	.1	.1	.3	1.3	2.4	3.0
80	.1		.2	.6	1.7	2.3	.1	.1	.2	.6	1.6	2.5
>80	.1	.1	.2	1.1	2.8	5.7	.1	.1	.5	1.0	3.6	6.0

TABLE 4. (Continued)

Age 55-64

Hearing level (dB)	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
					Military							
<0	7.9	14.6	9.6	2.3	1.7	1.1	11.2	15.2	12.9	4.5	1.7	2.3
5	18.0	21.9	13.5	4.5	2.8	2.3	26.4	24.7	18.0	10.1	3.4	2.8
10	29.2	25.3	14.6	9.6	1.1	5.1	20.2	21.4	13.5	5.6	7.9	2.8
15	20.2	14.6	15.2	7.9	5.1	3.9	14.0	19.1	19.7	11.8	5.1	3.4
20	11.2	10.1	12.9	9.6	5.6	4.5	14.0	8.4	11.2	10.1	6.7	7.3
25	3.9	4.5	10.7	7.9	10.1	8.4	7.9	4.5	7.3	7.9	8.4	7.3
30	5.1	3.4	5.1	8.4	5.6	6.7	2.3	2.8	5.6	10.1	8.4	10.7
35	1.1	1.1	3.4	5.6	11.2	8.4	1.7	1.7	2.3	3.9	9.6	7.9
40	1.7		3.4	10.7	6.2	6.7	.6	1.1	2.8	9.0	6.2	6.7
45	1.1	1.7	2.8	7.3	9.6	9.0	1.1	1.1	2.3	5.1	8.4	6.7
50		1.1	2.8	5.1	10.1	6.7	.6		2.8	5.1	2.3	6.7
55		.6	1.7	6.2	7.3	7.3			.6	5.1	7.9	8.4
60		1.1	.6	6.7	9.6	6.2				3.9	9.6	5.6
65			2.3	2.3	2.3	6.2				2.8	3.9	5.1
70	.6		.6	3.4	3.9	5.1			.6	2.3	3.9	2.8
75			1.1	1.7	3.9	2.8				1.7	1.7	2.8
80				.6	1.1	3.9			.6	1.1	2.3	.6
>80				.6	2.8	5.6					2.8	10.1
					Civilian							
<0	4.2	7.2	6.2	1.1	.5	.4	4.9	8.3	7.1	2.1	.8	.6
5	14.9	20.1	12.2	4.4	1.8	1.3	16.1	20.9	16.0	5.3	2.4	1.1
10	20.1	22.1	14.1	4.5	2.7	2.1	18.9	21.2	16.0	8.8	3.8	2.1
15	25.9	18.7	15.4	9.2	4.3	3.1	23.6	20.5	16.3	9.6	5.5	4.8
20	12.0	11.4	10.7	8.6	4.0	4.0	12.1	9.4	10.9	7.7	5.7	4.8
25	10.6	8.4	10.5	7.2	5.5	7.0	10.4	7.0	8.3	8.1	8.3	7.9
30	3.8	3.3	6.8	8.0	7.0	5.9	5.0	4.3	6.0	8.7	7.0	6.8
35	3.6	2.8	6.0	7.3	8.7	8.2	3.4	2.7	5.0	7.3	7.4	9.0
40	1.4	1.5	4.8	6.0	6.2	6.3	1.6	1.4	2.5	5.0	6.7	6.5
45	.9	1.4	3.3	7.9	8.4	7.7	1.3	1.6	2.8	7.0	8.2	7.7
50	.7	.9	2.9	7.5	8.6	8.5	.5	.4	2.3	6.7	6.9	6.5
55	.6	.6	2.3	9.2	11.3	10.0	.9	.8	2.6	7.7	8.7	7.0
60	.5	.7	1.7	6.2	8.3	5.4	.3	.5	1.4	5.4	7.1	7.2
65	.4	.4	1.4	5.8	8.1	7.8	.4	.4	1.3	3.6	7.5	6.7
70	.3	.4	.8	2.7	4.4	6.0	.1		.7	2.5	4.2	5.5
75	.1	.1	.3	1.6	3.3	5.1	.1	.1	.2	2.1	3.4	4.9
80	.1	.1	.2	1.4	2.4	2.8	.1	.1	.1	1.0	2.7	2.6
>80	.1	.1	.4	1.4	4.6	8.6	.4	.5	.6	1.6	4.0	8.3

TABLE 5. PERSONNEL WITH SIGNIFICANT THRESHOLD SHIFT

Age Group	Military N	Military %	Civilian N	Civilian %
18-24	2,112	15.0	48	13.1
25-34	4,141	19.6	428	19.6
35-44	3,963	35.5	656	33.9
45-54	873	50.3	1,295	46.3
55-64	112	62.9	770	54.6
	11,201	23.2	3,197	36.8

Total with STS = 14,398 (25.3%)